# Red Planet Recycle - Supervisor Meeting - Minutes

# Tuesday 14th February, 14.00

# Classroom 7

## Members Present

Yassen Abbas (YA) Lois Doig (LD) Bo Peng (BP)

Jamie Cassels (JC) Gareth Herron (GH) Charlotte Raymond (CR)

Malcolm Chambers (MC) Sam Jones (SJ) Samuel Walpole (SW)

Scott Clark (SC) Dylan Martin (DM) James Young (JY)

## Supervisors Present

Dr Prashant Valluri

Dr Lev Sarkisov

## Discussion of this week’s progress

### Water Treatment

### Urine Processing Assembly (GH)

* Major points of interest were identified
* Urine composition was defined.
* Composition of pretreatment solution was defined.
* The reasons for use of Vapour Compression Distillation were laid out - further analysis is waiting on a requested paper.

### Mostly Liquid Separator and Particulate Filter (LD)

* The nature of these two units was discussed.
* The particulate filter type (either gravity or pressure driven filter, or hydrocyclones) is to be determined this week.

### Multifiltration Beds (LD)

* The amount of empty bed contact time is determined was summarised and the dimensions of each component of the multifiltration bed was calculated.

### Gas Liquid Separator (LD)

* It was decided that a cyclone separator was the best selection for this task (over a vertical separator).

### Membrane Bioreactor (YA)

* Possible risks of failure and key dependencies were identified.
* Possible backups for each stage were identified to increase the reliability for the process.
  + It was suggested that a risk assessment of this sort could be carried out by a subteam after the design process to ensure consistent assessment criteria.

### Air Treatment

### Air Filtration and Trace Contaminant Removal System (CR)

* Following the meeting with Lester (9/2/12) techniques for particulate and trace contaminant removal were investigated.
* A HEPA filter was proposed for particulate removal.
* The ISS system was investigated for trace contaminant removal but was decided to be unsuitable due to large resupply costs (from replacing the carbon beds). For next week an alternative system using regenerable activated carbon beds will be investigated.

### CO2 Separation (SC, SJ and CR)

### Desiccant Beds

* Inlet temperature and relative humidity are assumed and the dew point temperature was found from a psychrometric graph.
* Silica Gel adsorption isotherms are needed (Lev is looking into this).
* Cycle time needed to be determined from the rest of the system.

### Precooler

* Is it necessary to have a precooler and an in bed heat exchanger?
  + Need to acknowledge that in reality there is no immediate cooling as stream enters the bed.
* Likely that heat of adsorption will have negligible effect.

### Zeolite 5A Bed

* Average fraction of solute removed is now 0.99 (up from 0.95) and mass balances must be changed accordingly.

### Regeneration

* Instead of having the vacuum system immediately applied at the beginning of desorption, it was decided that it was best to treat them both as separate systems and wait until the bed has been fully heated.
* Cycle time was determined as roughly 2 or 3 hours.

### CO2 Treatment - Sabatier Reactor (JC and JY)

### Sabatier Reactor

* Rate equations used to model the Sabatier Reactor were presented
* Non isothermal run 4 was presented as the best option as this gave lowest reactor volume and highest conversion.
* Water and mineral oil were discussed as two possibilities for the cooling of the reactor.

### Gas Separator

* To make the separation easier could 0.04kg of H2 be vented with the methane?
  + Need to assess implications of this i.e. resupply costs etc.

### O2 Generation - (DM, BP and SW)

### Electrolysis Unit

* Determined that a full and detailed design of the electrolysis system was not necessary.
* Key design parameters were identified to be designed and inform a choice on which commercially available unit is best.
* Hydrogenics was found to supply an electrolysis bed which catered to our needs.
* Should water vapour in equilibrium be taken into account?
  + Yes, a condensing plate later on in the system is a possibility.

### Gas-Liquid Separation

* Decision made to have a centrifugal G-L separator to separate electrolyte and gas.
  + More rigorous analysis is needed to fully discount gravity separation as it is a simpler and more reliable system.

### General Points

* There is a need for clarification of workload distribution i.e. a list of every single piece of equipment to ensure all tasks are distributed among the group.
* Later in the process have a subteam to systematically look at the entire system and identify key problem areas / reasons for failure / mutual interdependencies.
  + After whole design is completed.
  + Use a standard set of rules.
  + Identify common risks and issues.
  + Instead of separate groups looking at their own units individually.
* From a discussion about whether water should be used in heat exchangers or not.
  + It is a scarce and fully recycled resource which is needed for life support.
  + Should any water resupplied be demineralised so it can be used in processes (then extra minerals added later if water is required for drinking)? Or should potable water be sent up and then have a demineralisation unit to make this water suitable for use in processes?
* Main designs should recommend key parameters (sizing etc.) and key control.
  + Some units have greater scope for a more detailed design than others.

## To do as a group

* Detailed list of units and allocations for design.

## Positions Next Week

* Chairman - Charly Raymond
* Secretary - Dylan Martin

